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Summary

Two main approaches can be discerned in the literature on agentive self-awareness: a top-down approach, according to which agentive self-awareness is fundamentally holistic in nature and involves the operations of a central-systems narrator, and a bottom-up approach that sees agentive self-awareness as produced by low-level processes grounded in the very machinery responsible for motor production and control. Neither approach is entirely satisfactory if taken in isolation; however, the question of whether their combination would yield a full account of agentive self-awareness remains very much open.
In this paper, I contrast two disorders affecting the control of voluntary action: the anarchic hand syndrome and utilization behavior. Although in both conditions patients fail to inhibit actions that are elicited by objects in the environment but inappropriate with respect to the wider context, these actions are experienced in radically different ways by the two groups of patients. I discuss how top-down and bottom-up processes involved in the generation of agentive self-awareness would have to be related in order to account for these differences.

KEY WORDS: agentive self-awareness, anarchic hand syndrome, motor control, utilization behaviour, voluntary action.

Introduction

The phenomenology of action, after being neglected for a long time, is back on the agenda of philosophers and scientists alike. Indeed there is now a burgeoning body of literature on the mechanisms underlying "the sense of agency", which I will call "agentive self-awareness". Despite the recent explosion of interest in the topic, the complexity of agentive self-awareness remains underappreciated. Two main approaches can be discerned in the literature. According to a top-down approach, agentive self-awareness is fundamentally holistic in nature and involves the operations of a central-systems narrator. In contrast, a bottom-up approach maintains that agentive self-awareness is produced by low-level mechanisms – predictors and comparators – that are grounded in the very machinery responsible for motor production and control. Tim Bayne and I (1-3) recently argued that neither approach is entirely satisfactory if taken in isolation[1]. Instead, they should be combined and supplemented in order to yield a full account of agentive self-awareness.

This question of just how top-down and bottom-up processes interact to yield agentive self-awareness is still largely unanswered. One source of insight is the study of disturbances of motor function and of the way these disturbances can differentially impact on agentive self-awareness. In this paper, I will contrast two disorders affecting the control of voluntary action: the anarchic hand syndrome (AHS) and utilization behavior (UB). In both conditions, patients perform actions elicited by objects in the environment even though these actions are inappropriate with respect to the wider context. In both conditions then, patients fail to inhibit unwanted, stimulus-driven actions. Despite these behavioral similarities, from a phenomenological point of view, these actions are experienced in radically different ways by the two groups of patients. Whereas AHS patients report the actions of their anarchic hand as unintended and complain that their hand is out of their control, patients with UB make no such complaint and never exhibit surprise or perplexity at their own behavior. How can we account for these differences in agentive self-awareness? I start by giving a more detailed description of both syndromes and the brain lesions underlying them. I then argue that neither a pure top-down, narrative explanation, nor a pure bottom-up comparator explanation can account for the phenomenological discrepancy between AHS and UB. I further argue that merely combining the two is not sufficient to account for this discrepancy, but that the two sets of mechanisms must be supplemented with a third set for an explanation to be forthcoming.

The anarchic hand syndrome and utilization behavior

There has been some taxonomical confusion in the neurological literature, where the term "alien hand" has been used to refer to a variety of clinical conditions. These include the uncontrolled behavior of an upper limb, the failure to recognize ownership of a limb in the

[1] The discussion of narrator-based and comparator-based approaches to agentive self-awareness in this paper draws heavily on Bayne & Pacherie 2007 (2).

absence of involuntary movement, and involuntary movements of a hand concomitant with failure to recognize the hand as one's own. Della Sala and colleagues proposed restricting the term "alien hand" to conditions involving the feeling of non-belonging of a hand and introduced "anarchic hand" to refer to conditions where subjects perform involuntary movements with their hand but acknowledge the hand as theirs (4-8).
Here is how Marchetti and Della Salla (6) define AHS:

> *"Anarchic hand defines the occurrence of complex movements of an upper limb which are clearly goal-directed and well executed but unintended… These unwanted movements cannot be voluntarily interrupted and might interfere with the desired actions carried out by the other (healthy) hand. The patients are aware of the bizarre and potentially hazardous behavior of their hand but cannot inhibit it. They often refer to the feeling that one of their hands behaves as if it has a will of its own, but never deny that this capricious hand is part of their own body. The bewilderment comes from the surprising and unwanted actions, not from a sensation of lack of belonging of the hand."*

Some authors (9,10) further distinguish between two forms of the anarchic hand. One form is associated with anterior cortical lesions involving damage to the supplementary motor area (SMA), anterior cingulate and medial prefrontal cortex, particularly on the left, together with lesions of the anterior corpus callosum, and involves reflexive grasping, groping and compulsive tool manipulation with the anarchic hand, which the agent reports being unable to prevent. A second form of anarchic hand emerges after a right frontal and/or anterior callosal lesion and involves intermanual conflict, where the anarchic hand acts at cross-purposes with the other hand[2].
Anecdotal evidence and clinical observations suggest that that AHS is triggered opportunistically by nearby objects and that the erroneous behaviors in AHS are driven by environmental factors. These observations have recently received experimental confirmation (10,11). The essential deficit in AHS patients appears to be increased susceptibility to exogenous factors in the environment and thus impaired selection of appropriate motor programs. Once selected, however, the programs are directed towards a specific object in the environment and executed successfully. AHS behaviors therefore appear as purposeful, goal-directed actions.
Utilization behavior was first described by Lhermitte (12), who coined the term (13,14). Patients with UB reach out and automatically use objects in a manner that is instrumentally correct, but inappropriate for the particular context. For instance, in response to a pair of glasses being placed in front of him, a patient may pick the glasses up and put them on; if a second and then a third pair of glasses are placed in front of him, he will put them on, too, and will end up wearing all three pairs (12). In environments that are physically and socially more complex than the examiner/patient situation, these patients show even more striking over-reliance on social and physical cues to guide their behavior, what Lhermitte (15) calls "environmental dependency syndrome". On being told that the examiner's apartment he was visiting was a museum, one of Lhermitte's patients began commenting on the pictures as if they were on display. He selected pictures that had been placed on the floor and, noticing a hammer and nails, hammered a nail into the wall and hung a painting. Based on an analysis of lesion sites in six cases of UB, Lhermitte (12) concluded that UB arises following unilateral or bilateral frontal lesions. More specifically, he claimed that UB had an inferior frontal localization with damage to orbito-frontal structures. From their extensive review of studies documenting UB, Archibald et al. (13) more recently concluded that the pathophysiology of UB involves dysfunction in structures of the mesial frontal lobe and fronto-striatal pathways, most commonly the cingulate, caudate, and anterior and medial nuclei of the thalamus, all of which are closely connected.
Although both AHS and UB behaviors are automatically elicited by physical and/or social cues[3], there is a striking disanalogy in the phenomenology that these two categories of patients report. AHS patients do not deny that their anarchic hand is theirs, but they do deny that the actions carried out by that hand are theirs. They will comment on their anarchic hand, stating that "it will not do what I want it to do" (16), that "it has a mind of its own" and is "always trying to get into the act" (17), or that it "does what it wants to" (11). They are typically annoyed by the behavior of their anarchic hand and frustrated at their not being able to stop it. In stark contrast, UB patients never exhibit surprise or perplexity at their own behavior. When Lhermitte asked his patients why they had performed these actions, they said that they thought they were duties that had to be carried out and that they were natural things to do. Although patients with UB do not engage in elaborate confabulations, they do justify their actions with such claims as "I thought I had to do it" or "I thought you wanted me to use them" (12,15).
I now turn to models of agentive self-awareness. Two main approaches can be discerned in the literature: a holistic narrator-based approach and an atomistic comparator-based approach. Can either of them account for these discrepancies in agentive self-awareness?

The comparator approach to agentive self-awareness

According to one important approach to agentive self-awareness, the processes through which the agentive

[2] Posterior callosal lesions also produce intermanual conflict, but patients then tend to disown the hand and its actions. This should therefore be classified as a form of AHS rather than anarchic hand. Similarly, pure feelings of strangeness, of non-belonging of the hand without involuntary movements are associated with posterior callosal and/or parietal damage.
[3] Kritikos et al. (10) report that an intriguing aspect of their patient MA was the dissociation between his inability to perform actions with his anarchic left hand in accordance with his intentions and his preserved ability to execute the same movements under external command. For instance, when asked to grasp the examiner's fingers tightly with his left hand, he was unable to let go despite strenuous efforts to do so, but when the examiner ordered him to let go, he immediately did so. This suggests that in AHS behaviours, as in UB behaviors, over-reliance on exogeneous factors may not be restricted to physical cues but also include social cues, such as verbal commands.

self is generated are closely connected with the processes involved in motor specification and control. I will refer to this view as the comparator-based approach, on the grounds that the most influential versions of it turn to the role of comparators involved in forward models of action control to account for agentive self-awareness (18-20). According to this approach, the motor control system makes use of two kinds of internal models, which mimic aspects of the agent and of the external world. Inverse models compute the motor commands for achieving a desired state given the current state of the system and of the environment. Forward models are fed a copy of the motor commands and compute estimates of the sensory consequences of the ensuing movements. The control of action is thought to depend to a large extent on the coupling of inverse and forward models through a series of comparators, the results of the comparisons being used for various kinds of regulation.

Central to this comparator-based approach is the idea that these predictions and comparisons also underlie various aspects of agentive self-awareness. The suggestion is, first, that awareness of an intention or "urge" to perform an act requires the complete specification of that act and depends on awareness of its predicted sensory consequences; second, that when we are aware of initiating an act, what we are aware of is the releasing of the inhibitory mechanism that prevents the movement from happening before the appropriate time; third, that the sense of control is linked to the ongoing comparison of predicted and actual states as the action unfolds, with the sense of intentional causation in relation to the effects of our voluntary movements depending on the degree of congruency between the predicted and actual consequences of these movements; and fourth, that predictions made by forward models are used to filter sensory information and attenuate the component that is due to self-movement. Frith (21) indeed suggests that given that proprioceptive feedback is attenuated during voluntary movement though forward modelling, one possible indicator that I am performing a voluntary act could be a lack of proprioceptive experience. Finally, these predictions could also be used to distinguish between self-generated and externally induced sensory changes.

Several lines of evidence can be adduced in favour of the comparator approach and the idea that agentive self-awareness has its roots in the processes involved in motor preparation and control. One of these lines of evidence comes from Libet's well-known experiments on the timing of agency, in which healthy subjects report initiating a movement 80-200 ms before the movement actually occurs (22,23). In experiments extending Libet's work, Haggard and colleagues (24,25) confirmed both that intention judgments (awareness of the intention to move) and movement judgments (awareness of the movement onset) precede actual movement and provide evidence that awareness of intention and of action onset is linked to activity in premotor areas.

A second line of evidence for the comparator approach comes from studies showing that the perceptual consequences of self-generated actions are attenuated (26-28). Self-produced tickling sensations are both phenomenologically and physiologically attenuated, with the degree of attenuation being proportional to the spatial and temporal congruence between the predicted and actual feedback. Notably, schizophrenic patients suffering from delusion of control do not enjoy the same level of attenuation and are able to tickle themselves (28).

A third line of evidence for the comparator approach involves "intentional binding", a phenomenon in which self-produced causes and their effects are perceived as being closer together in subjective time (29,30). Haggard suggests that intentional binding is best explained in terms of predictive mechanisms of action control: it depends on efferent signals since it does not occur with passive movements and it causes anticipatory awareness of the effects of action, a shift that could be interpreted as prediction. This predictive theory suggests that the conscious experience of action is constructed at the time of the action itself, as an immediate by-product of the motor control circuits generating and controlling the actual physical movement. This view received confirmation in an experiment in which transcranial magnetic stimulation (TMS) was used to insert occasional involuntary movements of the right finger at a time when the subject already intended to press a button but had not yet done so. Intentional binding did not occur when the intention was interrupted by an imposed involuntary movement that caused the button press (30).

A fourth line of evidence for the comparator model comes from work by Sato and Yasuda (31), which confirms that the degree of congruency between predicted and actual sensory feedback modulates the sense of self-agency.

The four lines of evidence just reviewed converge on the view that the system(s) responsible for agentive experiences are nested within the very mechanisms responsible for motor production. Crucial to the comparator approach is the notion that agentive self-awareness can be generated by mechanisms that need not – and typically will not – have access to fully-fledged intentions. Of course, this research does not show that an agent's narrative self-conception plays no role in the generation of agentive self-awareness, but it does suggest that whatever role it plays will be one that takes a back seat to the comparator processes of motor control.

However, the phenomenological discrepancies presented by AHS patients and UB patients challenge a purely comparator-based approach to agentive self-awareness. In both conditions, the low-level mechanisms of motor production and control appear to be intact. The motor programs selected in AHS and UB behaviors are appropriate to the specific object in the environment at which they are directed, even though they may not be appropriate to the wider context. Furthermore, once selected, they are executed proficiently and successfully. Both AHS and UB behaviors therefore have all the appearance of purposeful, goal-directed actions. In both AHS and UB patients, correct information regarding the desired state, the actual state and the predicted state appear to be available to the motor system. Moreover, the comparator mechanisms between these states also appear to be intact, thus allowing error signals to be used for adjustments and corrections. Similarly, the mechanisms of sensory self-attenuation appear to be intact. Neither AHS nor UB patients report feelings of passivity vis-à-vis their movements, nor do they attribute them to alien forces, as happens in delusions of control in schizophrenia in which predictors are thought to be

impaired. Note, in particular, that although AHS patients will complain that their anarchic hand has a will of its own or does what it wants to do, they do not claim, as patients with delusions of control are wont to do, that some alien force, such as the CIA, a computer, or the examiner, has taken control of their hand. Similarly, the integrity of motor prediction models may contribute to explaining the difference in phenomenology between the anarchic hand and the alien hand sign associated with involuntary movements. The alien hand sign but not the anarchic hand is associated with damage to parietal areas which are thought to be involved in the predictive control of action (32).

If agentive self-awareness were generated solely by low-level mechanisms involved in motor control, we should not expect to see a discrepancy in agentive self-awareness between AHS and UB patients. They should enjoy the same kind of agentive self-awareness. Yet, they do not. If this discrepancy cannot be explained by the comparator model, can it be explained by the narrative approach?

The narrative approach to agentive self-awareness

Although the comparator approach permeates much of the recent literature on agentive self-awareness it does not enjoy a monopoly. A very different approach to agentive self-awareness refers to holistic, domain-general, central-systems mechanisms of self-interpretation that have more to do with narrative self-understanding than with motor control. According to the narrative approach, our sense of what, if anything, we are up to, is based on the operations of a high-level integrative process that draws on the agent's self-conception and tries to put the best spin on things that it can. We turn Dennett's intentional stance inwards, and treat ourselves as ideal agents, entities whose behavior needs to be made sense of in the light of what we take to be our beliefs, desires and intentions.

Many authors have expressed some sympathy with, and in some cases whole-hearted commitment to, the narrative approach. Interpreting split-brain studies in the light of Dennett's (33) view of the role of narrative in self-interpretation, Roser and Gazzaniga (34,35) have argued that the left hemisphere contains an interpreter, whose job it is to make sense of the agent's own behavior. Stephens and Graham suggest that a "subject's sense of agency regarding episodes in her psychological history might depend on her ability to integrate them into her larger picture of herself" (36). Carruthers suggests that "…our awareness of our own will results from turning our mind-reading capacities upon themselves, and coming up with the best interpretation of the information that is available… where this information doesn't include those acts of deciding themselves, but only the causes and effects of those events" (37). Holistic considerations also play an important role in Wegner's influential treatment of agentive self-awareness. According to his theory of apparent mental causation, the sense of agency is inferred from the existence of a match between a prior thought and an observed action. When such prior thoughts are not forthcoming, we readily confabulate them (38):

> *"The fact is, each of us acts in response to an unwieldy assortment of mental events, only a few of which may be easily brought to mind and understood as conscious intentions that cause our action. We may find ourselves at some point in life taking off a shoe and throwing it out the window, or at another point being sickeningly polite to someone we detest. At these junctures, we may ask ourselves, What am I doing? Or perhaps sound no alarms at all and instead putter blithely along assuming that we must have meant to do this for some reason. We perform many unintended behaviors that then require some artful interpretation to fit them into our view of ourselves as conscious agents. Even when we didn't know what we were doing in advance, we may trust our theory that we consciously will our actions and so find ourselves forced to imagine or confabulate memories of 'prior' consistent thoughts."*

A wide array of evidence can be marshalled in support of the narrative theory. When young children happen to achieve a goal by luck, they will say that they had intended the action that yielded that goal all along (39). Proponents of the narrative approach have also drawn on studies of patients with brain damage. Patients with anosognosia for hemiplegia say that they are currently raising their arm when, in fact, their arm has not moved. When it is pointed out to the patient that his arm has not moved, he may confabulate an excuse for his inertia (40,41). Split-brain subjects are prone to confabulate accounts of actions that are generated by their right hemisphere (42). Data from subjects in altered states of consciousness also support the narrative approach. For example, bizarre behaviors performed in response to hypnotic suggestion are often accompanied by elaborate rationalizations and confabulation on the part of the agent (43). Stephens and Graham (36) have proposed a narrative account of delusions of control and thought-insertion that builds on the suggestion made by the psychiatrist Louis Sass that schizophrenic patients with delusions of alien control no longer feel as though they are in control of their actions because "particular thoughts and actions may not make sense in relation to the whole" (44). Finally, the narrative approach derives support from a number of laboratory studies with normal subjects, in which it has been shown that agentive judgments can be modulated by priming and by various contextual parameters (45-48).

The narrative approach can be challenged in several ways[4]. One challenge concerns its ability to explain the phenomenological discrepancy between AHS and UB. Does it fare better than the comparator approach? Prima facie, it is difficult to see how one could account for this discrepancy between the AHS and UB drawing only on the resources provided by the narrative account. What narrative constraints might lead the patient with AHS to deny that the movement is hers and at the same time lead the patient with UB to incorporate his actions into his ongoing self-narrative? The theorist might suggest that the differences between these two syndromes

[4] For a discussion of several of the challenges confronting the narrative approach, see Bayne & Pacherie, 2007 (2).

reflect pre-morbid individual differences: perhaps AHS patients are predisposed to alienate their stimulus-driven actions, whilst UB patients are predisposed to self-ascribe their stimulus-driven actions. But this proposal is implausible, since one would expect pre-morbid differences in "attributional style" to be evenly distributed between AHS and UB patients.

Alternatively, the narrative theorist might suggest that one of these disorders involves damage not only to the mechanisms of action production, but also to the mechanisms of narrative self-interpretation. One possibility would be that AHS patients have impaired mechanisms of narrative self-interpretation. But this proposal, too, is implausible. Why should this narrative impairment be manifested only with respect to actions performed by the anarchic hand? Could it be the other way around, i.e. could it be UB patients who have impaired mechanisms of narrative self-interpretation? If this were the case, AHS patients would have intact mechanisms of self-interpretation and hence would realize that the behavior of their anarchic hand does not fit their self-conception. Indeed, in intermanual conflict, patients with AHS would be hard put to come up with a coherent narrative of their inconsistent actions and although the contradiction may not be as blatant when the anarchic hand is acting alone, what the hand does may still conflict with the agent's conscious intentions. In contrast, patients with UB would have impaired mechanisms of narrative self-interpretation resulting in self-attribution of their stimulus-driven actions by default, without these actions first being checked for consistency with their self-narrative. There is some evidence that UB patients have an abnormal narrative mechanism of self-interpretation, for although they confabulate explanations for why they acted, their confabulations are unusual. Unlike split-brain patients, patients with Korsakoff's syndrome, or post-hypnotic subjects, who will readily confabulate all sorts of personal reasons for their actions, the UB patient offers only impersonal rationalizations such as "I thought this was the thing to do" or "I thought you wanted me to do that". The fact that UB patients do not explain their actions in terms of their own desires or intentions suggests that, in a sense, they lack access to their self-narratives.

Thus, there is something to be said for this last proposal. We can also see how this narrator-based explanation could, in principle, be combined with a comparator-based approach to agentive self-awareness. Simply put, comparator-based mechanisms would be responsible for the generation of a thin form of agentive self-awareness, but the agent's narrative self-conception might place substantive constraints on the deliverances (or output) of these low-level mechanisms, determining whether they are to be accepted or vetoed. In patients with AHS, the intact narrative mechanisms of self-interpretation would veto the deliverances of the comparator-based mechanisms, while in patients with UB these narrative mechanisms would be impaired and have lost their capacity to veto, resulting in acceptance by default of the thin form of agentive self-awareness generated by comparator mechanisms.

Yet, there are further features of both UB and AHS that make it unlikely that this explanation provides the whole story. Rather, they suggest that a piece is still missing in the puzzle of agentive self-awareness.

Adding a piece to the puzzle

In both UB and AHS, the agents engage in stimulus-driven actions. Yet, full-blown agency of the kind humans normally enjoy involves more than just the capacity to perform or veto stimulus-driven actions. We also normally have a capacity for willed actions, i.e., actions driven by endogenously generated intentions, the performance of which might involve inhibiting stimulus-driven actions that conflict with them. The agency of AHS and UB patients is differentially impaired. Although both types of patients have lost the capacity to inhibit stimulus-driven actions, UB patients seem also to have lost the capacity to generate and act on endogenous intentions, whereas AHS patients have not lost this capacity. Lhermitte's descriptions of UB emphasize the loss of autonomy that these patients undergo. Not only are they powerless in the face of influences from the outside world, but, when lacking external stimulation to steer them into action, they exhibit mental inertia and apathy. In contrast, patients with AHS have retained the ability to prepare and execute willed actions (at least with the non-anarchic hand). Moreover, they do not merely notice a conflict between what their hand does and their consciously held goals; they try to stop their hand acting in unwanted ways and express frustration at the failure of their attempts at suppression. As noted by Marcel (49), environmentally driven behaviour is quite common in normal people especially during low arousal and after waking and it gives rise to characteristic slips of action. Yet, when normal people notice a conflict between what they do and their conscious intentions, they do not disown their actions in the way AHS patients disown the actions of their anarchic hand. The main reason for this difference appears to be that when normal people notice they are acting in unwanted ways, they have no trouble suppressing their action. Finally, the behavior of the anarchic hand is not always at odds with the patients' conscious intentions. For instance, Feinberg and colleagues (17) report that one specific and chronic complaint of a patient was that he felt that his right, anarchic hand anticipated future actions and performed movements prior to his actually intending them.

Several major theories of behavioral control posit a dichotomy between systems acting in response to exogenous stimuli and those operating according to endogenously generated goals and plans. In the model developed by Shallice and co-workers (50-52), the contention scheduling system handles routine and stimulus-driven actions, whereas the supervisory attentional system comes into play to select responses in accordance with higher-level goals. Similarly, Goldberg's influential model of motor control (7,53) distinguishes between a lateral system that is dominant during actions triggered by or performed in response to sensory stimuli and a medial system that dominates when the task is internally guided. Goldberg's model is based on the hypothesis that both AHS and UB result from an imbalance between lateral and medial systems. Accordingly, in AHS, following unilateral damage to the medial system, contralateral movements would be driven largely by the preserved, externally-triggered lateral system. In UB, damage to the medial system would be more extensive and bilateral.

More recently, Frith et al. (18) proposed that one lateral-

ized medial frontal structure, the SMA, was specifically involved in selection for action and inhibition of external action triggers and that a separate, high-level control system, akin to Shallice's supervisory attentional system, mediates goals and intended actions. In their model, AHS would result from unilateral damage to the SMA, but the high-level control system would be intact, allowing the patients to perceive the discrepancies between their intentions and their actions. In contrast, in UB this high-level system would be damaged.

Frith et al. further claim that in AHS motor control is impaired but not awareness of action, and that this is "because the impairment concerns the mechanisms by which the controller constructs and selects the precise movements required for an action. These processes are not available to consciousness" (18). But this hypothesis provides no explanation for the peculiar experience of Feinberg's patient who felt that that the movements of his hands anticipated his intentions, or for the difference in phenomenology between normal people performing unwanted environmentally driven actions and patients with AHS. Furthermore, the claim that activity in the SMA contributes nothing to agentive self-awareness is in contradiction with experimental evidence: indeed, Fried et al. (54) reported that electrical stimulation of the SMA could elicit in their patients a subjective "urge" to perform a movement in the absence of an overt motor response. More recently, in an experiment using TMS, Haggard and Magno (25) instructed subjects to react to an auditory stimulus by pressing a response key and to report the position reached by a rotating clockhand at the point at which they pressed the key. They showed that applying TMS over the primary motor cortex created a large delay of the actual reaction time (movement onset) but a much smaller delay of the time of awareness of movement, whereas applying TMS over the SMA led to a much smaller delay of actual reaction time but to a greater delay in the awareness of movement.

These clinical and experimental data suggest that endogenously generated actions may have a specific phenomenological signature, namely a sense of urge or effort. One may further speculate that for an action to be experienced as caused by an intention at the time of the action itself, it is not enough that intention and action be narratively consistent. Rather, in the same way that the intentional binding of movement and effect appears to depend on efferent signals from the motor control circuits that generate and control the physical movement itself, the binding of intention and action may depend on efferent signals from the higher-level control system that implements the intention.

If there is indeed a form of agentive self-awareness characteristic of willed actions, it seems that neither a comparator-based approach nor a narrator-based approach can capture it. The narrative approach cannot account for the phenomenological signature of willed actions, because the processes it calls into play are interpretive processes rather than processes actually involved in high-level motor control. The comparator-based approach cannot account for the phenomenological signature of willed actions because it holds the system(s) responsible for agentive experiences to be nested within low-level mechanisms of motor production common to willed and to stimulus-driven actions. But, if a central characteristic of human motor control is its multi-layered hierarchical structure, why tie agentive self-awareness solely to lower mechanisms of motor control and not conceive of it as also multi-layered? By the pitching their interpretations either too high or too low, the comparator-based and narrative approaches both miss the central layer of agentive self-awareness.

UB patients have lost the capacity for full-blown agency: they can neither form nor implement willed intentions and their self-agentive awareness is downsized accordingly. Having lost the capacity to will their actions, they have also lost the capacity to experience them as unwilled. AHS patients have not lost the capacity to form willed intentions but they have lost the capacity to implement them when they involve movements of the anarchic hand. Their self-agentive awareness reflects their motor impairment: they experience their will as powerless.

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